

Appendix D Glossary

This list of glossary terms was compiled from existing EPA definitions and supplemented, where necessary, by additional terms and definitions. The wording of selected items may have been modified from the original in order to assist readers who are new to risk assessment more readily comprehend the underlying concept of the glossary entry. As such, these glossary definitions constitute neither official EPA policy nor preempt or in any way replace any existing legal definition required by statute or regulation. A more extensive list of glossary terms can be found in ATRA Volume 1.

A

Acceptable Risk - The likelihood of suffering disease or injury that will be tolerated by an individual, group, or society. The level of risk that is determined to be acceptable may depend on a variety of issues, including scientific data, social, economic, legal, and political factors, and on the perceived benefits arising from a chemical or process.

Accuracy - The measure of the correctness of data, as given by the difference between the measured value and the true or standard value.

Activity Patterns - A series of discrete events of varying time intervals describing information about an individual's lifestyle and routine. This information typically includes the locations visited, the amount of time spent in the locations, and a description of what the individual was doing in each location.

Acute Effect - Any toxic effect produced with a short period of time following an exposure, for example, minutes to a few days

Acute Exposure - One dose (or exposure) or multiple doses (or exposures) occurring within a short time relative to the life of a person or other organism (e.g., approximately 24 hours or less for humans).

Adjusted Exposure Concentration - Also called a refined exposure concentration, an estimate of exposure concentration that has been refined, usually by application of an exposure model, to better understand how people in a particular location interact with contaminated media.

Adverse Environmental Effect - Defined in the CAA section 112(a)(7) as "any significant and widespread adverse effect, which may reasonably be anticipated, to wildlife, aquatic life, or other natural resource, including adverse impacts on populations of endangered or threatened species or significant degradation of environmental quality over broad areas."

Adverse Health Effect - A health effect from exposure to air contaminants that may range from relatively mild and temporary (e.g., eye or throat irritation, shortness of breath, or headaches) to permanent and serious conditions (e.g., birth defects, cancer or damage to lungs, nerves, liver, heart, or other organs), and which negatively affects an individual's health or well-being, or reduces an individual's ability to respond to an additional environmental challenge.

Affected (or Interested) Parties - Individuals and organizations potentially acted upon or affected by chemicals, radiation, or microbes in the environment or influenced favorably or adversely by proposed risk management actions and decisions.

Aggregate Exposure - The combined exposure of an individual (or defined population) to a specific agent or stressor via relevant routes, pathways, and sources.

Aggregate Risk - The risk resulting from aggregate exposure to a single agent or stressor.

AirData - An EPA website (<http://www.epa.gov/air/data/info.html>) that provides access to yearly summaries of United States air pollution data, taken from EPA's air pollution databases. The data include all fifty states plus District of Columbia, Puerto Rico, and the U. S. Virgin Islands. AirData has information about where air pollution comes from (emissions) and how much pollution is in the air outside our homes and work places (monitoring).

Air Emissions - The release or discharge of a pollutant into the air.

Air Toxic - Any air pollutant (other than a criteria pollutant) that causes or may cause cancer, respiratory, cardiovascular, or developmental effects, reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans or adverse effects on the environment. See [hazardous air pollutant](#) and [criteria pollutant](#).

Ambient Medium (e.g., Ambient Air) - Material surrounding or contacting an organism (e.g., outdoor air, indoor air, water, or soil), through which chemicals can reach an organism.

AMTIC - Ambient Monitoring Technology Information Center. An EPA website that contains information and files on ambient air quality monitoring programs, details on monitoring methods, monitoring-related documents and articles, information on air quality trends and nonattainment areas, and federal regulations related to ambient air quality monitoring. [<http://www.epa.gov/ttn/amtic/>, 2003]

Analysis - The systematic application of specific theories and methods, including those from natural science, social science, engineering, decision science, logic, mathematics, and law, for the purpose of collecting and interpreting data and drawing conclusions about phenomena. It may be qualitative or quantitative. Its competence is typically judged by criteria developed within the fields of expertise from which the theories and methods come.

Analysis Plan - A plan that provides all the details of exactly how each part of the risk assessment will be performed. It usually describes in detail what analyses will be performed, how they will be performed, who will perform the work, schedules, resources, quality assurance/quality control requirements, and documentation requirements.

AP-42 - A compilation of air pollutant emission factors. Volume I of the fifth edition addresses stationary point and area source emission factors. AP-42 is accessible on the Air CHIEF website (<http://www.epa.gov/ttn/chief/ap42/>) and is also included on the Air CHIEF CD-ROM.

Area of Impact - The geographic area affected by a facility's emissions (also known as the zone of impact).

Area Source (legal sense) - A stationary source that emits less than 10 tons per year of a single hazardous air pollutant (HAP) or 25 tons per year of all HAPs combined.

Area Source (modeling sense) - An emission source in which releases are modeled as coming from a 2-dimensional surface. Emissions from the surface of a wastewater pond are, for example, often modeled as an area source.

Assessment Questions - The questions asked during the planning/scoping phase of the risk assessment process to determine what the risk assessment will evaluate.

ATSDR (Agency for Toxic Substances and Disease Registry) - An Agency of the U.S. Department of Health and Human Services, whose goal is to serve the public by using the best science, taking responsive public health actions, and providing health information to prevent harmful exposures and diseases to toxic substances. Its website (www.atsdr.cdc.gov) includes information on hazardous substances [e.g., toxicological profiles, minimal risk levels (MRLs)], emergency response, measuring health effects, hazardous waste sites, education and training, publications, and special issues (e.g., Children Health).

B

Background Levels - The concentration of a chemical already present in an environmental medium due to sources other than those under study. Two types of background levels may exist for chemical substances: (a) Naturally occurring levels of substances present in the environment, and (b) Anthropogenic concentrations of substances present in the environment due to human associated activities (e.g., automobiles, industries).

Background Source - Any source from which pollutants are released and contribute to the background level of a pollutant, such as volcano eruptions, windblown dust, or manmade source upwind of the study area.

Best Available Control Technology (BACT) - An emission limitation based on the maximum degree of emission reduction (considering energy, environmental, and economic impacts) achievable through application of production processes and available methods, systems, and techniques. BACT does not permit emissions in excess of those allowed under any applicable Clean Air Act provisions. Use of the BACT concept is allowable on a case by case basis for major new or modified emissions sources in attainment areas and applies to each regulated pollutant.

Best Professional Judgement - Utilizing knowledge based on education and experience to determine the best course of action during the course of performing a risk assessment project.

Bias - systematic error introduced into sampling or analysis by selecting or encouraging one outcome or answer over others.

Bioaccumulation - The net accumulation of a substance by an organism as a result of uptake from and or all routes of exposure (e.g., ingestion of food, intake of drinking water, direct contact, or inhalation).

Bounding Estimate - An estimate of exposure or risk that is higher or lower than that incurred by any person in the population. Bounding estimates are useful in developing statements that exposures or risks are within an estimated range.

Breathing Zone - Air in the vicinity of an organism from which respired air is drawn. Personal monitors are often used to measure pollutants in the breathing zone.

Bright Line - Specific levels of risk or of exposure that are meant to provide a practical distinction between what is considered “safe” and what is not.

Building Downwash (Plume Downwash) - The interaction of a plume with a structure, such as a building, which causes the plume to fall to ground.

C

Cancer - A group of related diseases characterized by the uncontrolled growth of abnormal cells.

Cancer Incidence - The number of new cases of a disease diagnosed each year.

Cancer Risk Estimates - The probability of developing cancer from exposure to a chemical agent or a mixture of chemicals over a specified period of time. In quantitative terms, risk is expressed in values ranging from zero (representing an estimate that harm certainly will not occur) to one (representing an estimate that harm certainly will occur). The following are examples of how risk is commonly expressed: 1.E-04 or 1×10^{-4} = a risk of 1 additional cancer in an exposed population of 10,000 people (i.e., 1/10,000); 1.E-5 or 1×10^{-5} = 1/100,000; 1.E-6 or 1×10^{-6} = 1/1,000,000.

Cancer Slope Factor (CSF) - An upper bound (approximating a 95% confidence limit) on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship; that is, for exposures corresponding to risks less than 1 in 100. This term is usually used to refer to oral slope factors (i.e., slope factors used for assessing ingestion exposure).

Carcinogen(ic) - An agent capable of inducing cancer.

Carcinogenesis - The origin or production of a benign or malignant tumor. The carcinogenic event modifies the genome and/or other molecular control mechanisms of the target cells, giving rise to a population of altered cells.

Census Bureau (Bureau of the Census) - A Bureau within the Department of Commerce, this is the country’s preeminent statistical collection and dissemination agency of national demographic information. It publishes a wide variety of statistical data about people, housing, and the economy of the nation. The Census Bureau conducts approximately 200 annual surveys and conducts the decennial census of the United States population and housing and the quinquennial economic census and census of governments.

Census Block - An area bounded by visible and/or invisible features shown on Census Bureau maps. A block is the smallest geographic entity for which the Census Bureau collects and tabulates 100-percent decennial census data.

Census Tract - A small, relatively permanent statistical subdivision of a county or statistically equivalent entity, delineated for data presentation purposes by a local group of census data users or the geographic staff of a regional census center in accordance with Census Bureau guidelines. Designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions at the time they are established, census tracts generally contain between 1,000 and 8,000 people, with an optimum size of 4,000 people. Census tract boundaries are delineated with the intention of being stable over many decades, so they generally follow relatively permanent visible features. However, they may follow governmental unit boundaries and other invisible features in some instances; the boundary of a state or county (or statistically equivalent entity) is always a census tract boundary.

Census Tract (or Census Block) Internal Point - A set of geographic coordinates (latitude and longitude) that is located within a specified geographic entity such as a Census Tract or Census Block. For many Census Tracts or Blocks, this point represents the approximate center of the Census Tract or Block; for some, the shape of the entity or the presence of a body of water causes the central location to fall outside the Census Tract or Block or in water, in which case the point is relocated to land area within the Census Tract or Block. The geographic coordinates are shown in degrees to six decimal places in census products.

Chemical Abstracts Service Registry Number (CASRN) - A unique, chemical-specific number used in identifying a substance. The registry numbers are assigned by the Chemical Abstract Service, a division of the American Chemical Society. (Note that some mixtures of substances, such as mixtures of various forms of xylene, are also given CAS numbers.)

Chemicals of Potential Concern - Chemicals that may pose a threat to the populations within the study area. These are the chemicals which are carried through the risk assessment process.

Chemical Speciation - Detailed identification of the specific identities and forms of chemicals in a mixture.

Chemical Transformation - The change of one chemical into another.

Chronic Exposure - Continuous exposure, or multiple exposures, occurring over an extended period of time or a significant fraction of the animal's or the individual's lifetime.

Chronic Health Effects - An effect which occurs as a result of repeated or long term (chronic) exposures.

Cohort - A group of people within a population that can be aggregated because the variation in a characteristic of interest (e.g., exposure, age, education level) within the group is much less than the group-to-group variation across the population.

Community - The persons associated with an area who may be directly affected by area pollution because they currently live in or near the area, or have lived in or near the area in the past (i.e., current or past residents), members of local action groups, local officials, tribal governments, health professionals, and local media. Other entities, such as local industry, may also consider themselves part of the community.

Comparative Risk Assessment - The process of comparing and ranking various types of risks to identify priorities and influence resource allocations.

Conceptual Model - A written description and/or a visual representation of actual or predicted relationships between humans or ecological entities and the chemicals or other stressors to which they may be exposed.

Control Technology/Measures - Equipment, processes or actions used to reduce air pollution at the source.

Cost-Benefit Analysis - An evaluation of the costs which would be incurred versus the overall benefits of a proposed action, such as the establishment of an acceptable exposure level of a pollutant.

Criteria Air Pollutant - One of six common air pollutants determined to be hazardous to human health and regulated under EPA's National Ambient Air Quality Standards (NAAQS). The six criteria air pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter. The term "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Cumulative Risk - The combined risk from aggregate exposures to multiple agents or stressors.

Cumulative Risk Assessment - An analysis, characterization, and possible quantification of the combined risks to health or the environment from multiple agents or stressors.

D

Data Quality - The encompassing term regarding the quality of information used for analysis and/or dissemination. Utility, objectivity, and integrity are constituents of data quality.

Data Quality Objectives (DQOs) - Qualitative and quantitative statements derived from the DQO process that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support the decisions.

Data Quality Objectives Process - A systematic planning tool to facilitate the planning of environmental data collection activities. Data quality objectives are the qualitative and quantitative outputs from the DQO Process.

Deposition (Wet and Dry) - The removal of airborne substances to available surfaces that occurs as a result of gravitational settling and diffusion, as well as electrophoresis and thermophoresis in the absence of active precipitation (Dry) or in the presence of active precipitation (Wet).

Deterministic - A methodology relying on point (i.e., exact) values as inputs to estimate risk; this obviates quantitative estimates of uncertainty and variability. Results are also presented as point values. Uncertainty and variability may be discussed qualitatively, or semi-quantitatively by multiple deterministic risk estimates.

Direct Exposure - Contact between a receptor and a chemical where the chemical is still in the medium to which it was originally released. For example, direct exposure occurs when a pollutant is released to the air and a person breathes that air.

Dispersion - Pollutant or concentration mixing due to turbulent physical processes.

Disease Cluster - An unusual number, real or perceived, of health events (i.e., reports of cancer) grouped together in time and location.

Dose-Response Assessment - A determination of the relationship between the magnitude of an administered, applied, or internal dose and a specific biological response. Response can be expressed as measured or observed incidence, percent response in groups of subjects (or populations), or as the probability of occurrence within a population.

E

Ecological Risk Assessment - The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

Emission Factor - The relationship between the amount of pollution produced and the amount of raw material processed or product produced. For example, an emission factor for a blast furnace making iron could be the number of pounds of particulates released per ton of raw materials used.

Emission Inventory - A listing, by source, of the amount of air pollutants discharged into the atmosphere in a particular place. Two of the more important publicly available emissions inventories for air toxics studies are the National Emissions Inventory (NEI) and the Toxics Release Inventory (TRI).

Emission Rate - The amount of a given substance discharged to the air per unit time, expressed as a fixed ratio (e.g., tons/yr).

Emissions Monitoring - The periodic or continuous physical surveillance or testing to determine the pollutant levels discharged into the atmosphere from sources such as smokestacks at industrial facilities and exhaust from motor vehicles, locomotives, or aircraft.

Emissions Tracking System (ETS) - This EPA system contains all emissions data submitted under various clean air market programs. Data from Continuous Emissions Monitoring Systems at utilities sends the emission data to the utility's computer system, which then compiles the data for submission to EPA on a quarterly basis. At the end of each calendar year, EPA compares tons of emissions emitted with the allowance holdings of the utility unit to ensure that it is in compliance with the relevant program.

Environmental Data - Any measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology. Environmental data include information collected directly from measurements, produced from models, and compiled from other sources such as data bases or the literature.

Environmental Medium - Any one of the major categories of material found in the physical environment (e.g., surface water, ground water, soil, or air), and through which chemicals or pollutants can move.

Epidemiology - The study of disease patterns in human populations.

Exposure - Contact made between a chemical, physical, or biological agent and the outer boundary of an organism.

Exposure Assessment - An identification and evaluation of a population exposed to a toxic agent, describing its composition and size, as well as the type, magnitude, frequency, route and duration of exposure.

Exposure Concentration - The concentration of a chemical in its transport or carrier medium (i.e., an environmental medium or contaminated food) at the point of contact.

Exposure Factors - Any of a variety of factors that relate to how an organism interacts with or is otherwise exposed to environmental pollutants (e.g., ingestion rate of contaminated fish). Such factors are used in the calculation of exposure to toxic chemicals.

Exposure Investigation (in Public Health Assessment) - The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure Modeling - The mathematical equations simulating how people interact with chemicals in their environment.

Exposure Pathway - The course a chemical or physical agent takes from a source to an exposed organism. An exposure pathway includes a source and release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) also is included.

Exposure Route - The way a chemical enters an organism after contact (e.g., by ingestion, inhalation, dermal absorption).

Exposure Scenario - A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals, and populations (numbers, characteristics and habits) which aid the investigator in evaluating and quantifying exposure in a given situation.

Exposure Unit (in Geographical Information System applications) - The geographical area in which a receptor moves and contacts the contaminated medium during the period of exposure.

F

Factor Information Retrieval System (FIRE) - A database management system containing EPA's recommended emission estimation factors for criteria and hazardous air pollutants. FIRE includes information about industries and their emitting processes, the chemicals emitted, and the emission factors themselves. FIRE allows easy access to criteria and hazardous air pollutant emission factors obtained from the Compilation of Air Pollutant Emission Factors (AP-42), Locating and Estimating (L&E) documents, and the retired AFSEF and XATEF documents.

Fate and Transport - A description of how a chemical is carried through and changes in the environment.

Fate and Transport Analysis - The general process used to assess and predict the movement and behavior of chemicals in the environment.

Fate and Transport Modeling - The mathematical equations simulating a physical system which are used to assess and predict the movement and behavior of chemicals in the environment.

Fence Line - Delineated property boundary of a facility.

Field Study - Scientific study made in the ambient air to collect information that can not be obtained in a laboratory.

Fugitive Release - Emission of a chemical to the air that does not occur from a stack, vent, duct, pipe or other confined air stream (e.g., leaks from joints).

Future Scenario - A scenario used in risk assessment to anticipate potential future exposures of individuals (e.g., a housing development could be built on currently vacant land).

G

Geographic Information Systems (GIS) - A computer program that allows layering of different types of spatial information (i.e., on a map) to provide a better understanding of the characteristics of a certain place.

Generally Available Control Technology (GACT) Standard - These standards are less stringent standards than the Maximum Available Control Technology (MACT) standards, and are allowed at the Administrator's discretion for area sources according to the 1990 Clean Air Act Amendments for area sources.

Guidelines (human health and ecological risk assessment) - Official documentation stating current U.S. EPA methodology in assessing risk of harm from environmental pollutants to human populations and ecological receptors.

H

Hazard - In a general sense, “hazard” is anything that has a potential to cause harm. In risk assessment, the likelihood of experiencing a noncancer health (and in some cases a cancer) effect is called hazard (not risk).

Hazard Identification - The process of determining whether exposure to an agent can cause a particular adverse health effect (e.g., cancer, birth defect) and whether the adverse health effect is likely to occur in humans at environmentally relevant doses.

Hazard Index (HI) - The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. The HI is calculated separately for chronic, subchronic, and shorter-term duration exposures.

Hazardous Air Pollutants (HAP) - Defined under the Clean Air Act as pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Currently, the Clean Air Act regulates 187 chemicals and chemical categories as HAPs.

Hazard Quotient (HQ) - The ratio of a single substance exposure level over a specified time period (e.g., chronic) to a reference value (e.g., an RfC) for that substance derived from a similar exposure period.

Health Endpoint - An observable or measurable biological event used as an index to determine when a deviation in the normal function of the human body occurs.

Health Outcome Data (in Public Health Assessment) - Community-specific health information such as morbidity and mortality data, birth statistics, medical records, tumor and disease registries, surveillance data, and previously conducted health studies that may be collected at the local, state, and national levels by governments, private health care organizations, and professional institutions and associations.

Health Outcomes Study (in Public Health Assessment) - An investigation of exposed persons designed to assist in identifying exposure or effects on public health. Health studies also define the health problems that require further inquiry by means of, for example, a health surveillance or epidemiologic study.

Health Education (in Public Health Assessment) - Programs designed with a community to help it know about health risks and how to reduce these risks.

Health Consultation (in Public Health Assessment) - A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical.

High-End Exposure Estimate - A plausible estimate of individual exposure or dose for those persons at the upper end of an exposure or dose distribution, conceptually above the 90th percentile, but not higher than the individual in the population who has the highest exposure or dose.

Human Exposure Model (HEM) - An EPA model combining the Industrial Source Complex Short Term air dispersion model (ISCST) with a national set of meteorology files, U.S. census data, and a risk calculation component that can be used to estimate individual and population risks.

I

Indirect Exposure Pathway - An indirect exposure pathway is one in which a receptor contacts a chemical in a medium that is different from the one to which the chemical was originally released (an example occurs with dioxin, which is emitted into the air, deposited on soil and accumulated in plants and animals which are then consumed by humans).

Individual Risk or Hazard - The risk or hazard to an individual in a population rather than to the population as a whole.

Indoor Source - Objects or places within buildings or other enclosed spaces that emit air pollutants.

Industrial Source Complex (ISC) Model - A steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. This model can account for the following: settling and dry deposition of particles; downwash; point, area, line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment. ISC3 operates in both long-term (ISCLT) and short-term (ISCST) modes.

Ingestion - Swallowing (such as eating or drinking).

Ingestion Exposure - Exposure to a chemical by swallowing it (such as eating or drinking).

Inhalation - Breathing.

Inhalation Exposure - Exposure to a chemical by breathing it in.

Inhalation Unit Risk (IUR) - The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of $1 \mu\text{g}/\text{m}^3$ in air. The interpretation of unit risk would be as follows: if unit risk = $2 \times 10^{-6} \mu\text{g}/\text{m}^3$, 2 excess tumors may develop per 1,000,000 people if exposed daily for a lifetime to a concentration of $1 \mu\text{g}$ of the chemical in 1 m^3 of air.

Intake - The process by which a substance crosses the outer boundary of an organism without passing an absorption barrier, e.g., through ingestion or inhalation.

Integrated Risk Information System (IRIS) - An EPA database which contains information on human health effects that may result from exposure to various chemicals in the environment. IRIS was initially developed for EPA staff in response to a growing demand for consistent information on chemical substances for use in risk assessments, decision-making and regulatory activities. The information in IRIS is intended for those without extensive training in toxicology, but with some knowledge of health sciences.

Iterative Process - Replication of a series of actions to produce successively better results, or to accommodate new and different critical information or scientific inferences.

Isopleths - A delineated line or area on a map that represent equal values of a variable.

L

Line Source - A theoretical one-dimensional source from which releases may occur (e.g., roadways are often modeled as a one-dimensional line).

M

Major Source - Under the Clean Air Act, a stationary source that emits more than 10 tons or more per year of a single hazardous air pollutant (HAP) or 25 or more tons per year of all HAPs.

Maximum Achievable Control Technology (MACT) - Under the Clean Air Act, a group of technology based standards, applicable to both major and some area sources of air toxics, that are aimed at reducing releases of air toxics to the environment. MACT standards are established on a source category by source category basis.

Maximum Exposed Individual (MEI) - The MEI represents the highest estimated risk to an exposed individual, regardless of whether people are expected to occupy that area.

Maximum Individual Risk (MIR) - An MIR represents the highest estimated risk to an exposed individual in areas that people are believed to occupy.

Metric (or Measure) of Exposure - The quantitative outcome of the exposure assessment. For air toxics risk assessments, personal air concentration (or adjusted exposure concentration) is the metric of exposure for the inhalation route of exposure and intake rate is the metric of exposure for the ingestion route of exposure.

Measurement - In air toxics assessment, a physical assessment (usually of the concentration of a pollutant) taken in an environmental or biological medium, normally with the intent of relating the measured value to the exposure of an organism.

Media Concentrations - The amount of a given substance in a specific amount of environmental medium. For air, the concentration is usually given as micrograms (μg) of substance per cubic meter (m^3) of air; in water as μg of substance per L of water; and in soil as mg of substance per kg of soil.

Meteorology - The science of the atmosphere, including weather.

Microscale Assessment - An air monitoring network designed to assess concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.

Microenvironment - A small 3-dimensional space (e.g., an office, a room in a home) that can be treated as homogeneous (or well characterized) with regard to exposure concentration of a chemical.

Middle Scale Assessment - An air monitoring network designed to assess concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.

Minimal Risk Levels (MRL) - Derived by ATSDR, an MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. MRLs can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

Mixtures - Any set of multiple chemical substances occurring together in an environmental medium.

Mobile Source Air Toxics - Air toxics that are emitted from non-stationary objects that release pollution. Mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers. Another example is a portable generator.

Model - A mathematical representation of a natural system intended to mimic the behavior of the real system, allowing description of empirical data, and predictions about untested states of the system.

Model Uncertainty - Uncertainty due to necessary simplification of real-world processes, mis-specification of the model structure, model misuse, or use of inappropriate surrogate variables or inputs.

Modeling - An investigative technique using a mathematical or physical representation of a system or theory that accounts for all or some of its known properties.

Modeling Node - In air quality modeling, the location where impacts are predicted.

Monitoring - Periodic or continuous physical surveillance or testing to determine pollutant levels in various environmental media or in humans, plants, and animals.

Monte Carlo Technique- A repeated random sampling from the distribution of values for each of the parameters in a generic exposure or risk equation to derive an estimate of the distribution of exposures or risks in the population.

Multipathway Assessment - An assessment that considers more than one exposure pathway. For example, evaluation of exposure through both inhalation and ingestion would be a multipathway assessment. Another example would be evaluation of ingestion of contaminated soil and ingestion of contaminated food.

Multipathway Exposure - When an organism is exposed to pollutants through more than one exposure pathway. One example would be exposure through both inhalation and ingestion. Another example would be ingestion of contaminated soil and ingestion of contaminated food.

Multipathway Risk - The risk resulting from exposure to pollutants through more than one pathway.

N

National Ambient Air Quality Standards (NAAQS) - Maximum air pollutant standards that EPA has set under the Clean Air Act for attainment by each state. Standards are set for each of the criteria pollutants.

National Air Toxics Assessment (NATA) - EPA's ongoing comprehensive evaluation of air toxics in the U.S. Activities include expansion of air toxics monitoring, improving and periodically updating emission inventories, improving national- and local-scale modeling and risk characterization, continued research on health effects and exposures to both ambient and indoor air, and improvement of assessment tools.

National Emissions Inventory (NEI) - EPA's primary emissions inventory of HAPs.

National Emissions Standards for Hazardous Air Pollutants (NESHAPs) - Emissions standards set by EPA for hazardous air pollutants. Also commonly referred to as the MACT standards.

National Emissions Trends (NET) Database - The NET database is an emission inventory that contains data on stationary and mobile sources that emit criteria air pollutants and their precursors. The database also includes estimates of annual emissions of these pollutants from point, area, and mobile sources. The NET is developed every three years (e.g., 1996 and 1999) by EPA, and includes emission estimates for all 50 States, the District of Columbia, Puerto Rico, and the Virgin Islands.

Natural Source - Non-manmade emission sources, including biological (biogenic sources such as plants) and geological sources (such as volcanoes), and windblown dust.

Neighborhood Scale Assessment - An air monitoring network designed to assess concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range.

New Source Performance Standards - Uniform national EPA air emission standards which limit the amount of pollution allowed from new sources or from modified existing sources.

Noncarcinogenic Effect - Any health effect other than cancer. Note that, while not all noncancer toxicants cause cancer, all carcinogens exhibit noncarcinogenic effects.

Nonpoint Source (NEI sense) - Diffuse pollution sources that are not assigned a single point of origin (e.g., multiple dry cleaners in a county which are only described in an inventory in the aggregate).

Nonroad Mobile Sources - Sources such as farm and construction equipment, gasoline-powered lawn and garden equipment, and power boats and outdoor motors that emit pollutants.

Non Steady-state Model - A dynamic model; a mathematical formulation describing and simulating the physical behavior of a system or a process and its temporal variability.

North American Industry Classification System (NAICS) - NAICS replaced the Standard Industrial Classification (SIC) beginning in 1997. This industry-wide classification system has been designed as the index for statistical reporting of all economic activities of the U.S., Canada, and Mexico. NAICS industries are identified by a 6-digit code. The international NAICS agreement fixes only the first five digits of the code. The sixth digit, where used, identifies subdivisions of NAICS industries that accommodate user needs in individual countries.

O

Office of Air and Radiation (OAR) - EPA's Office responsible for providing information about air pollution, clean air, air quality and radiation. OAR develops national programs, technical policies, and regulations for controlling air pollution and radiation exposure. OAR is concerned with pollution prevention, indoor and outdoor air quality, industrial air pollution, pollution from vehicles and engines, radon, acid rain, stratospheric ozone depletion, and radiation protection.

Office of Air Quality, Planning, and Standards (OAQPS) - An EPA Office within OAR whose primary mission is to preserve and improve air quality in the United States. As part of this goal, OAQPS monitors and reports on air quality, air toxics, and emissions. They also respond to visibility issues, as they relate to the level of air pollution. In addition, OAQPS is tasked by the EPA with providing technical information for professionals involved with monitoring and controlling air pollution, creating governmental policies, rules, and guidance (especially for stationary sources), and educating the public about air pollution and what can be done to control and prevent it.

OAQPS Toxicity Table - The EPA Office of Air and Radiation recommended default chronic toxicity values for hazardous air pollutants. They are generally appropriate for screening-level risk assessments, including assessments of select contaminants, exposure routes, or emission sources of potential concern, or to help set priorities for further research. For more complex, refined risk assessments developed to support regulatory decisions for single sources or substances, dose-response data may be evaluated in detail for each "risk driver" to incorporate appropriate new toxicological data. (<http://www.epa.gov/ttn/atw/toxsource/summary.html>)

Office of Radiation and Indoor Air (ORIA) - An EPA Office within OAR whose mission is to protect the public and the environment from the risks of radiation and indoor air pollution. The Office develops protection criteria, standards, and policies; works with other programs within EPA and other agencies to control radiation and indoor air pollution exposures; provides technical assistance to states through EPA's regional offices, and to other agencies having radiation and indoor air protection programs; directs an environmental radiation monitoring program; responds to radiological emergencies; and evaluates and assesses the overall risk and impact of radiation and indoor air pollution.

Office of Transportation and Air Quality (OTAQ) - An EPA Office within OAR whose mission is to reconcile the transportation sector with the environment by advancing clean fuels and technology, and working to promote more liveable communities. OTAQ is responsible for carrying out laws to control air pollution from motor vehicles, engines, and their fuels. Mobile sources include: cars and light trucks, large trucks and buses, farm and construction equipment, lawn and garden equipment, marine engines, aircraft, and locomotives.

Onroad Mobile Source - Any mobile source of air pollution such as cars, trucks, motorcycles, and buses that travels on roads and highways.

Open Pit Source - Large, open pits, such as surface coal mines and rock quarries.

Operating Permit Program - A program required by the Clean Air Act; requires existing industrial sources to obtain an "operating permit". The operating permit program is a national permitting system that consolidates all of the air pollution control requirements into a single, comprehensive "operating permit" that covers all aspects of a source's year-to-year air pollution activities.

P

Particle-bound - Reversibly absorbed or condensed onto the surface of particles.

Particulates/Particulate Matter (PM) - Solid particles or liquid droplets suspended or carried in the air.

Partitioning - The separation or division of a substance into two or more compartments. Environmental partitioning refers to the distribution of a chemical into various media (soil, air, water, and biota).

Partitioning Model - Models consisting of mathematical equations that estimate how chemicals will divide (i.e., partition) among abiotic and biotic media in a given environment based on chemical- and site- specific characteristics.

Pathway Specific Risk - The risk associated with exposure to a chemical agent or a mixture of chemicals via a specific pathway (e.g., inhalation of outdoor air).

Persistent, Bioaccumulative, and Toxic (PBT) Chemicals - Highly toxic, long-lasting substances that can build up in the food chain to levels that are harmful to human and ecosystem health. They are associated with a range of adverse health effects, including effects on the nervous system, reproductive and developmental problems, cancer, and genetic impacts.

Persistence - Refers to the length of time a compound stays in the environment, once introduced. A compound may persist for very short amounts of time (e.g., fractions of a second) or for long periods of time (e.g., hundreds of years).

Personal Monitoring - A measurement collected from an individual's immediate environment using active or passive devices to collect the samples.

Photolysis - The breakdown of a material by sunlight; an important mechanism for the degradation of contaminants in air, surface water, and the terrestrial environment.

Physical Factors - Manmade and/or natural characteristics or features that influence the movement of pollutants in the environment (e.g., settling velocity, terrain effects).

Planning and Scoping - The process of determining the purpose, scope, players, expected outcomes, analytical approach, schedule, deliverables, QA/QC, resources, and document requirements for the risk assessment.

Point of Exposure - The location of potential contact between an organism and a chemical or physical agent.

Point of Release - Location of release to the environment.

Point Source (NEI sense) - A source of air pollution which can be physically located on a map.

Point Source (non-NEI sense) - A stack, vent, duct, pipe or other confined air stream from which chemicals may be released to the air.

Population Risk or Hazard - Population risk refers to an estimate of the extent of harm for the population or population segment being addressed. It often refers to an analysis of the number of people living at a particular risk or hazard level.

Potential Risk - Estimated likelihood, or probability, of injury, disease, or death resulting from exposure to a potential environmental hazard.

Precision - A measure of the reproducibility of a measured value under a given set of circumstances.

Present Scenario - Risk characterizations using present scenarios to estimate risks to individuals (or populations) that currently reside in areas where potential exposures may occur (e.g., using an existing population within some specified area).

Primary Standard - A pollution limit based on health effects. Primary standards are set for criteria air pollutants.

Probabilistic - A type of statistical modeling approach used to assess the expected frequency and magnitude of a parameter by running repetitive simulations using statistically selected inputs for the determinants of that parameter (e.g., rainfall, pollutants, flows, temperature).

Probabilistic Risk Assessment/Analysis - Calculation and expression of health risks using multiple risk descriptors to provide the likelihood of various risk levels. Probabilistic risk results approximate a full range of possible outcomes and the likelihood of each, which often is presented as a frequency distribution graph, thus allowing uncertainty or variability to be expressed quantitatively.

Probability Density Function (PDF) - The PDF is alternatively referred to in the literature as the probability function or the frequency function. For continuous random variables, that is, the random variables which can assume any value within some defined range (either finite or infinite), the probability density function expresses the probability that the random variable falls within some very small interval. For discrete random variables, that is, random variables which can only assume certain isolated or fixed values, the term probability mass function (PMF) is preferred over the term probability density function. PMF expresses the probability that the random variable takes on a specific value.

Problem Statement - A statement of the perceived problem to be studied by the risk assessment. Problem statements often also include statements about how the problem is going to be studied.

Public Health Consultation (Public Health Assessment) - See health consultation.

Public Health Assessment (PHA) - An evaluation of hazardous substances, health outcomes, and community concerns at a hazardous waste site or other potential source of pollutants to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.

Public Health Advisory (in Public Health Assessment) - A statement made by a regulatory agency that a release of hazardous substances or contamination by microbial pathogens poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public Health Hazard Category (in Public Health Assessment) - Statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. ATSDR's five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Q

Qualitative Uncertainty Estimate - A detailed examination, using qualitative information, of the systematic and random errors of a measurement or estimate.

Quality Assurance Project Plan - A document describing in comprehensive detail the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

Quality Assurance - An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control - The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of its users. The aim is to provide data quality that is satisfactory, adequate, and dependable.

R

Receptor (modeling sense) - In fate/transport modeling, the location where impacts are predicted.

Receptor (non-modeling sense) - The entity which is exposed to an environmental stressor.

Reference Concentration (RfC) - An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Reference Dose (RfD) - An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Reference Media Evaluation Guides (RMEG) - A type of comparison value derived by ATSDR to protect the most sensitive populations. They do not consider carcinogenic effects, chemical interactions, multiple route exposure, or other media-specific routes of exposure, and are very conservative concentration values designed to protect sensitive members of the population.

Regional/National Scale Assessment - An air monitoring network designed to assess from tens to hundreds of kilometers, up to the entire nation.

Relative Potency Factor - The ratio of the toxic potency of a given chemical to that of an index chemical.

Release Parameters - The specific physical characteristics of the release (e.g., stack diameter, stack height, release flow rate, temperature).

Representativeness - The degree to which one or a few samples are characteristic of a larger population about which the analyst is attempting to make an inference.

Residual Risk - The extent of health risk from air pollutants remaining after application of the Maximum Achievable Control Technology (MACT).

Resources - Money, time, equipment, and personnel available to perform the assessment.

Risk (in the context of human health) - The probability of injury, disease, or death from exposure to a chemical agent or a mixture of chemicals. In quantitative terms, risk is expressed in values ranging from zero (representing the certainty that harm will not occur) to one (representing the certainty that harm will occur). (Compare with hazard.)

Risk Assessor(s) - The person or group of people responsible for conducting a qualitative and quantitative evaluation of the risk posed to human health and/or the environment by environmental pollutants.

Risk Assessment - For air toxics, the scientific activity of evaluating the toxic properties of a chemical and the conditions of human or ecological exposure to it in order both to ascertain the likelihood that exposed humans or ecological receptors will be adversely affected, and to characterize the nature of the effects they may experience.

Risk Assessment Work Plan - A document that outlines the specific methods to be used to assess risk, and the protocol for presenting risk results. The risk assessment workplan may consist of one document or the compilation of several workplans that, together, constitute the overall risk assessment workplan.

Risk Characterization - The last phase of the risk assessment process in which the information from the toxicity and exposure assessment steps are integrated and an overall conclusion about risk is synthesized that is complete, informative and useful for decision-makers. In all cases, major issues and uncertainty and variability associated with determining the nature and extent of the risk should be identified and discussed. The risk characterization should be prepared in a manner that is clear, transparent, reasonable and consistent.

Risk Communication - The exchange of information about health or environmental risks among risk assessors and managers, the general public, news media, and other stakeholders.

Risk Management - The decision-making process that uses the results of risk assessment to produce a decision about environmental action. Risk management includes consideration of technical, scientific, social, economic, and political information.

Risk Manager(s) - The person or group responsible for evaluating and selecting alternative regulatory and non-regulatory responses to risk.

S

Sample - A small portion of something designed to evaluate the nature or quality of the whole (for example, one or several samples of air used to evaluate air quality generally).

Sampling and Analysis Plan - An established set of procedures specifying how a sample is to be collected, handled, analyzed, and the data validated and reported.

Science Advisory Board (SAB) - A group of recognized, non-EPA experts who advise EPA on science and science policy.

Scenario Uncertainty - Uncertainty due to descriptive errors, aggregation errors, errors in professional judgment, or incomplete analysis.

SCREEN3 - An air dispersion model developed to obtain conservative estimates of air concentration for use in screening level assessments through the use of conservative algorithms and meteorology.

Screening-level Risk Assessment - A risk assessment performed with few data and many conservative assumptions to identify exposures that should be evaluated more carefully for potential risk.

Secondary Production/Pollutant - Formation of pollutants in the atmosphere by chemical transformation of precursor compounds.

Secondary Standard - A pollution limit based on environmental effects (e.g., damage to property, plants, visibility). Secondary standards are set for criteria air pollutants.

Sensitive Subgroups - Identifiable subsets of the general population that, due to differential exposure or susceptibility, are at greater risk than the general population to the toxic effects of a specific air pollutant (e.g., depending on the pollutant and the exposure circumstances, these may be groups such as subsistence fishers, infants, asthmatics, or the elderly).

Simulation - A representation of a problem, situation in mathematical terms, especially using a computer.

Source - Any place or object from which pollutants are released.

Source Category - A group of similar industrial processes or industries that are contributors to releases of hazardous air pollutants. The 1990 amendments to the Clean Air Act (CAA) requires that the EPA publish and regularly update a listing of all categories and subcategories of major and area sources that emit hazardous air pollutants.

Source Characterization - The detailed description of the source (e.g., location, source of pollutant releases, pollutants released, release parameters).

Spatial Variability - The magnitude of difference in contaminant concentrations in samples separated by a known distance.

SPECIATE - EPA's repository of Total Organic Compound (TOC) and Particulate Matter (PM) speciated profiles for a variety of sources for use in source apportionment studies. The profiles in the system are provided as a library of available profiles for source-receptor and source apportionment type models, such as Chemical Mass Balance 8 (CMB8).

Stack - A chimney, smokestack, or vertical pipe that discharges used air.

Stack Release - The release of a chemical through a stack.

Stack Testing - The monitoring, by testing, of chemicals released from a stack.

Stakeholder(s) - Any organization, governmental entity, or individual that has a stake in or may be impacted by a given approach to environmental regulation, pollution prevention, energy conservation, etc.

Standard Industrial Classification (SIC) - A method of grouping industries with similar products or services and assigning codes to these groups.

Standard Operating Procedure (SOP) - A established set of written procedures adopted and used to guide the work of for a specific project. For example, an air monitoring study would include SOPs on sample collection and handling and SOPs on analytical requirements and data validation and reporting.

Stationary Source - A source of pollution that is fixed in space.

Steady-state Model - Mathematical model of fate and transport that uses constant values of input variables to predict constant values of receiving media concentrations.

Stochastic - Involving or containing a random variable; involving probability or chance.

Stressor - Any physical, chemical, or biological entity that can induce adverse effects on ecosystems or human health.

Support Center for Regulatory Models (SCRAM) - An EPA website that is a source of information on atmospheric dispersion models (e.g., ISCST3, SCREEN 3, and ASPEN) that support regulatory programs required by the Clean Air Act. Documentation and guidance for these computerized models are a major feature of this website. This site also contains computer code, data, and technical documents that deal with mathematical modeling for the dispersion of air pollutants.

Susceptibility - Increased likelihood of an adverse effect, often discussed in terms of relationship to a factor that can be used to describe a human subpopulation (e.g., life stage, demographic feature, or genetic characteristic).

Susceptible Subgroups - A susceptible subgroup exhibits a response that is different or enhanced when compared to the responses of most people exposed to the same level of the same substance. It may refer to life stages, for example, children or the elderly, or to other segments of the population, for example, asthmatics or the immune-compromised, and will vary with and be particular to the chemical or type of chemical.

T

Target Organ - The biological organ(s) most adversely affected by exposure to a chemical substance (e.g., the site of the critical effect).

Target Organ Specific Hazard Index (TOSHI) - The sum of hazard quotients for individual air toxics that affect the same organ/organ system or act by similar toxicologic processes

Temporal Variability - The difference in contaminant concentrations observed in samples taken at different times.

Terrain Effects - The impact on the airflow as it passes over complex land features such as mountains.

Threshold Effect - An effect (usually an adverse health effect) for which there is an exposure level below which the effect is not expected to occur.

Threshold Toxicant - A chemical for which there is an exposure level below which an adverse health outcome is not expected to occur.

Tiered Analysis - An analysis arranged in layers/steps. Risk assessments/analyses are often conducted in consecutive layers/steps that begin with a reliance on conservative assumptions and little data (resulting in less certain, but generally conservative answers) and move to more study-area specific data and less reliance on assumptions (resulting in more realistic answers). The level of effort and resources also increases with the development of more realistic data.

Toxic Air Pollutants - see hazardous air pollutant.

Toxicity - The degree to which a substance or mixture of substances can harm humans or environmental receptors.

Toxicity Assessment - Characterization of the toxicological properties and effects of a chemical, with special emphasis on establishment of dose-response characteristics.

Toxicology - The study of harmful interactions between chemicals and biological systems.

Toxic Release Inventory (TRI) - Annual database of releases to air, land, and water, and information on waste management in the United States of over 650 chemicals and chemical compounds. This data is collected under Section 313 of the Emergency Planning and Community Right to Know Act.

Trajectory - The track taken by a parcel of air as it moves within the atmosphere over a given period.

Transformation - The change of a chemical from one form to another.

Transparency - Conducting a risk assessment in such a manner that all of the scientific analyses, uncertainties, assumptions, and science policies which underlie the decisions made throughout the risk assessment are clearly stated (i.e., made readily apparent).

Turbulence - Irregular motion of the atmosphere, as indicated by gusts and lulls in the wind.

U

Uncertainty - Uncertainty represents a lack of knowledge about factors affecting exposure/toxicity assessments and risk characterization and can lead to inaccurate or biased estimates of risk and hazard. Some of the types of uncertainty include scenario uncertainty, parameter uncertainty, and model uncertainty.

Uncertainty analysis - A detailed examination of the systematic and random errors of a measurement or estimate (in this case a risk or hazard estimate); an analytical process to provide information regarding the uncertainty.

Uncertainty Factor (UF) - One of several, generally 10-fold factors, used in operationally deriving the RfD and RfC from experimental data. UFs are intended to account for (1) the variation in sensitivity among the members of the human population; (2) the uncertainty in extrapolating animal data to humans, i.e., interspecies variability; (3) the uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure to lifetime exposure, i.e., extrapolating from subchronic to chronic exposure; (4) the uncertainty in extrapolating from a LOAEL rather than from a NOAEL; and (5) the uncertainty associated with extrapolation from animal data when the data base is incomplete.

Unit Risk Estimate (URE) - The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of $1\mu\text{ g/L}$ in water, or $1\mu\text{g/m}^3$ in air. The interpretation of unit risk would be as follows: if the water unit risk = $2 \times 10^{-6}\mu\text{g/L}$, 2 excess tumors may develop per 1,000,000 people if exposed daily for a lifetime to $1\mu\text{g}$ of the chemical in 1 liter of drinking water.

Urban Scale Assessment - An air monitoring network designed to assess the overall, citywide conditions with dimensions on the order of 4 to 50 kilometers. This scale would usually require more than one site for definition.

V

Vapor - The gas given off by substances that are solids or liquids at ordinary atmospheric pressure and temperatures.

Variability - Refers to the observed differences attributable to true heterogeneity or diversity in a population or exposure parameter. Examples include human physiological variation (e.g., natural variation in body weight, height, breathing rate, drinking water intake rate), weather variability, variation in soil types and differences in contaminant concentrations in the environment. Variability is usually not reducible by further measurement of study, but it can be better characterized.

Volume Source - In air dispersion modeling, a three dimensional volume from which a release may occur (e.g., a gas station modeled as a box from which chemicals are emitted).

W

Watershed - The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Wind Rose - A graphical display showing the frequency and strength of winds from different directions over some period of time.